*Volume 26* November, 1940 *Number 11*

# Lubrication

## A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Modern Farm Machinery Requires Quality Lubricants

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

# LUBRICATION OF POWER FARMING MACHINERY

## Draw-Bar Equipment

Gang Plows · Disk and Tooth Harrows · Cultivators · Planters, Drills and Seeders · Manure Spreaders · Grain Binders · Grain Headers · Reapers · Harvester-Thresher Rigs · Hay Loaders and Stackers · Hay Tedders · Corn Pickers and Binders, Etc.

**BEARINGS**

Oil Cup or Hand Lubrication
TEXACO Motor Oils

Grease Lubrication
TEXACO Marfaks or
TEXACO 919 Lubricant S

**GEARS**

When Enclosed
TEXACO Motor Oils are used in engine, or
TEXACO Thubans

When Exposed
TEXACO Crater

## Belt-Driven Machinery

Threshing Machines · Corn Huskers and Shredders · Ensilage Cutters · Saw Milling Machines · Pumps · Lighting Sets, Etc.

**BEARINGS**

Force Feed Lubricators, Chain Oilers, Oil Cups, Wick Feeds and Hand Lubrication
TEXACO Motor Oil

Grease Lubrication
TEXACO Marfaks or
TEXACO 919 Lubricant S

Ball and Roller Bearings
TEXACO Starfak Greases

**CHAINS**

Where Lubrication is deemed advisable, Clean, Dry and Dip in
TEXACO Motor Oils or
TEXACO Thubans

**GEARS**

When Enclosed
TEXACO Motor Oils or
TEXACO Thubans

When Exposed
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# LUBRICATION

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# Modern Farm Machinery Requires Quality Lubricants

POWER farming has gone to pressure lubrication. This holds true whether we are dealing with the simplest form of grease cup or a full force feed oiling system on a modern tractor. The farmer is interested in knowing just what pressure lubrication involves. He has seen that it can be developed by hand, or automatically through some form of pumping mechanism. In addition, he should know that bearing design may also create some pumping action which will assist in maintaining complete and continuous filling of the clearance spaces with oil, while motion of the shaft prevails.

It is unnecessary to tell the farmer how his various machinery operates. He is a far better mechanic than the many who actually work at this trade. He has to be, for minor repairs must be made intelligently, when and if they are necessary—not when it is convenient to get to a repair shop. There are some things about lubrication, however, which may be vague to him; also, the influence which design may have upon maintenance of lubrication.

**The progressive farmer is a production specialist, so he appreciates the value of machinery which has been designed to give him maximum production. He should likewise appreciate the value of protective lubrication. The use of quality lubricants assures of this. But quality is not an item which can be judged by sight, smell, or feel. It is best proven by performance and confidence in the ability and integrity of the manufacturer.**

Builders of farming machinery have shown creditable appreciation of the benefits their customers should derive from more carefully planned lubrication. It would have been perfectly practicable to carry on with the conventional oil can and to make wide-spread usage of screw-down compression grease cups. Many farmers did not expect anything better and usually they had time to maintain a fairly decent lubrication schedule.

But one couldn't use better steels, improved bearings or oil-tight gear housings and logically accept inferior or out-moded methods of lubrication. Nor could the machinery builders expect the petroleum industry to make available to agriculture those high-grade lubricants prepared for the automotive industry if methods worthy of their quality were not provided for application.

## GREASE LUBRICATION

This trend towards improved lubrication of farming machinery logically turned first to the

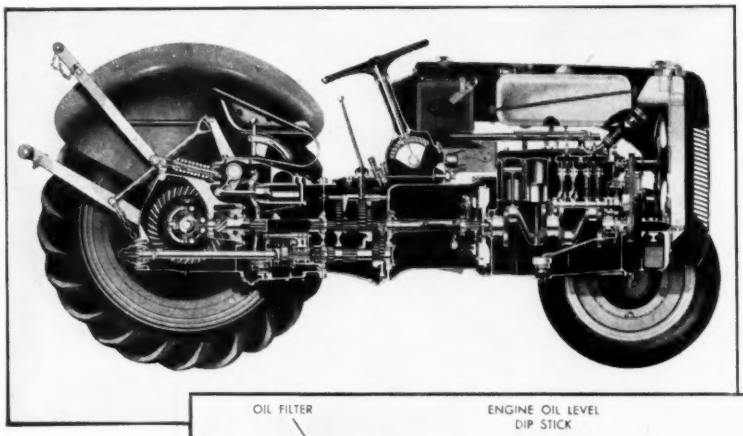
pressure grease gun as grease lubrication is so widely preferred for the various types of bearings which are found aside from the tractor engine. The machinery builders profited by the experience of the automotive industry. If grease was the most practicable lubricant for shackle bolts, universal joints and wheel bearings, it should certainly prove equally satisfactory on parts of similar design on farming machinery. So they proceeded accordingly.

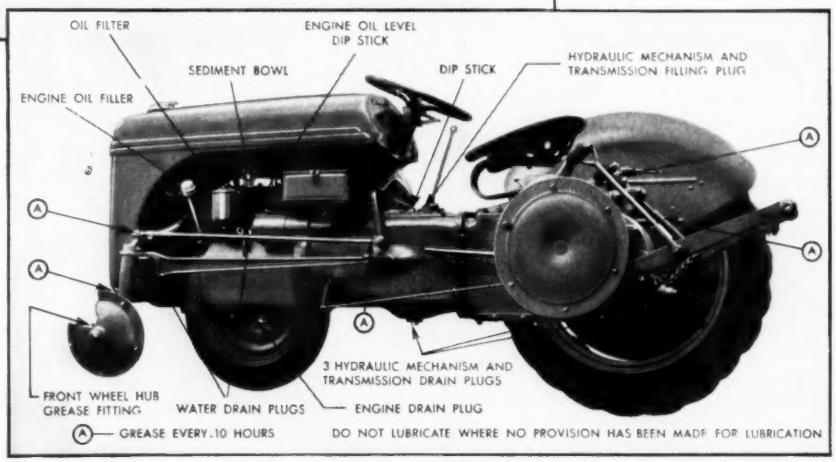
This wide-spread usage of grease in agriculture is of particular interest to the progressive farmer as he must know how to evaluate the available materials in order to get best results.

The grease chemist has perfected a wide variety of such products, many of specific characteristics to meet certain definite operating conditions. When such greases are used under conditions adverse to their physical structure or chemical make-up, they may fail to give satisfactory lubrication.

In farming, the operating conditions are comparable with automotive service, with the added possibility of quite extreme heat and considerable dust during the summer months. There is also the possibility of considerable water wash.

The farmer is aware of all this, but quite naturally he is not always familiar with the characteristics which distinguish a quality grease from an ordinary product. As materials and methods of manufacture are involved, let us approach this from the chemist's viewpoint.




OIL FILTER
ENGINE OIL LEVEL DIP STICK
SEDIMENT BOWL
DIP STICK
HYDRAULIC MECHANISM AND TRANSMISSION FILLING PLUG
ENGINE OIL FILLER
A
3 HYDRAULIC MECHANISM AND TRANSMISSION DRAIN PLUGS
FRONT WHEEL HUB GREASE FITTING
WATER DRAIN PLUGS
ENGINE DRAIN PLUG
A GREASE EVERY 10 HOURS
DO NOT LUBRICATE WHERE NO PROVISION HAS BEEN MADE FOR LUBRICATION

*Courtesy of Ferguson-Sherman Manufacturing Corporation*

Fig. 1—The Ford tractor with Ferguson Sherman system has pressure lubrication by gear pump supplying direct pressure oiling to crank shaft, cam shaft and connecting rod bearings, also to timing gears. Other gears are bath lubricated with troughs in rear axle housing to carry oil to axle bearings.

## Grease Manufacture

It is practicable for the grease chemist to select raw materials which will be quite capable of standing up under high temperature and water conditions, but the means of application is the measure of how extensive contamination with dust may occur.

Presuming that temperature extremes will not exceed 160 degrees Fahr., when the machinery is exposed to the direct heat of the sun, the grease chemist is able to use lime soaps as the basic material for certain farm equipment greases. These soaps also resist the dissociative effect of water in which they are comparatively insoluble. For certain other greases, he will use a soda or aluminum soap according to the characteristics desired in the finished grease.

### *Lime Base Grease*

Lime soaps when compounded with medium or medium-heavy straight mineral oils produce greases of smooth, buttery texture, of yellow to amber color and good lubricating ability up to around 175 degrees Fahr. They fall within the conventional cup grease or chassis lubricant classification.

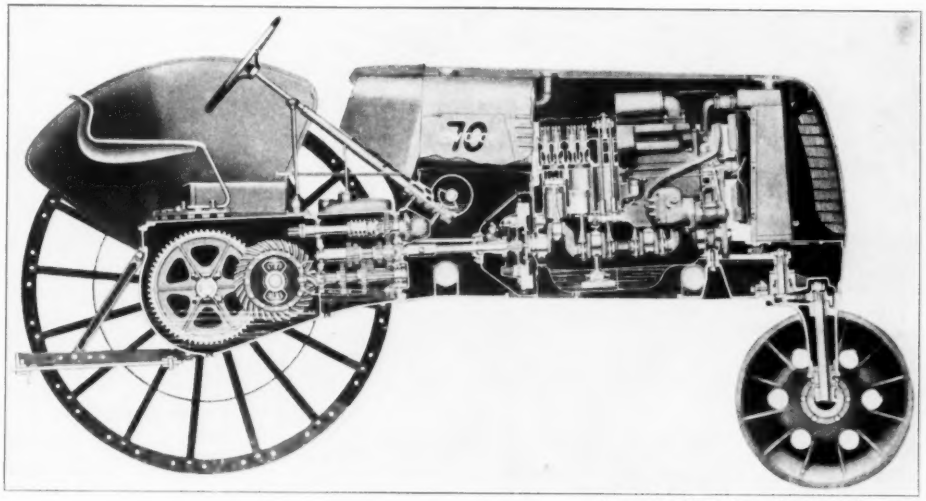
### *Sodium Base Grease*

Soda soaps produce a grease of longer fibre

especially when compounded with heavy-bodied oils within the gear lubricant viscosity range. They are especially useful for lubrication when construction or wear might allow

*Aluminum Base Grease*

Aluminum soap greases are even more stringy than those of sodium soap base. This characteristic cannot be associated with the

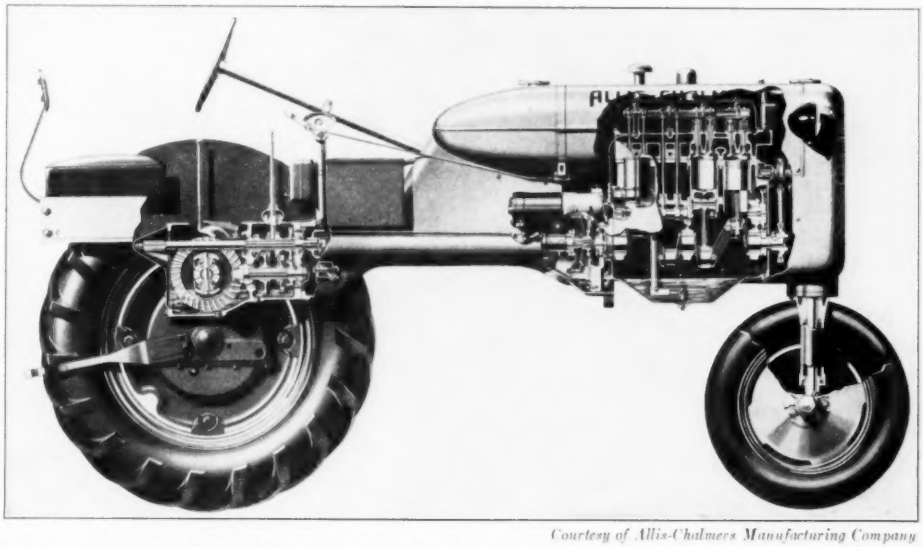



*Courtesy of Oliver Farm Equipment Company*

Fig. 2—The Oliver Standard "70" Tractor. On this machine the engine is pressure lubricated, the transmission and differential run in oil, and ball and roller bearings are used on all transmission shafts.

leakage. Here their structural nature or stringiness along with quite a marked degree of adhesiveness enables such a grease to resist

fibrous nature of the grease. These products are more smooth than lime soap greases and possessed of a distinctive sheen. Like the



*Courtesy of Allis-Chalmers Manufacturing Company*

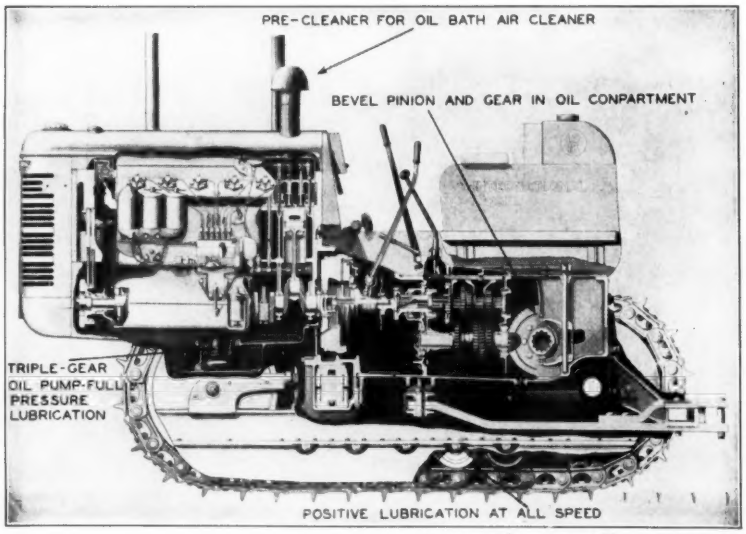
Fig. 3—Lubrication of the new Allis-Chalmers Model "C" Tractor is by controlled pressure to crankshaft, camshaft, and rocker arm bearings. All chassis parts are packed with grease and sealed; this eliminates the need for frequent regreasing. The steering, transmission, differential, and final drive gears run in oil.

being forced out of bearing clearances, to follow or train with ball or roller bearing assemblies, or to form a protective collar around the exterior of bearings to prevent entry of dust.

lime soap greases, they are insoluble in water and also limited as to the amount of increase in temperature they can stand without breaking down.

## Measuring the Durability

As durability of a grease is a distinct asset especially when the farm operates a considerable amount of machinery which may be on a regular lubrication schedule, resistance to chemical breakdown is an important factor. This is measured in the laboratory by very accurate testing devices which denote rate of oxygen absorption, and resistance to oxidation and gum formation. The latter is the result of oxidation. Soda soap or soda-lime base greases resist reaction with oxygen most effectively; so they are usually regarded as most durable.


PRE-CLEANER FOR OIL BATH AIR CLEANER
BEVEL PINION AND GEAR IN OIL COMPARTMENT
TRIPLE-GEAR OIL PUMP-FULL PRESSURE LUBRICATION
POSITIVE LUBRICATION AT ALL SPEED

*Courtesy of International Harvester Company*

Fig. 4—Full pressure is applied to lubrication of the International tractor. Note other features also which pertain to lubrication.

Testing devices of this nature are not available to the farmer, nor are they necessary if he has confidence in the quality of the greases he is using. Performance tells.

The grease chemist assures of this by generous use of laboratory equipment to evaluate the relative qualities of a grease before it is considered marketable.

## Physical Characteristics

### *Melting Point*

The melting point of a grease is indicative of the extent to which it will stand high temperatures. If bearing temperatures should run comparatively high, the melting point of any grease to be used under such conditions should be sufficiently above the average temperature to insure against reduction of body and the possibility of separation of the soap from the oil. Most cup greases cannot be heated very much above their melting point without the danger of such separation occurring.

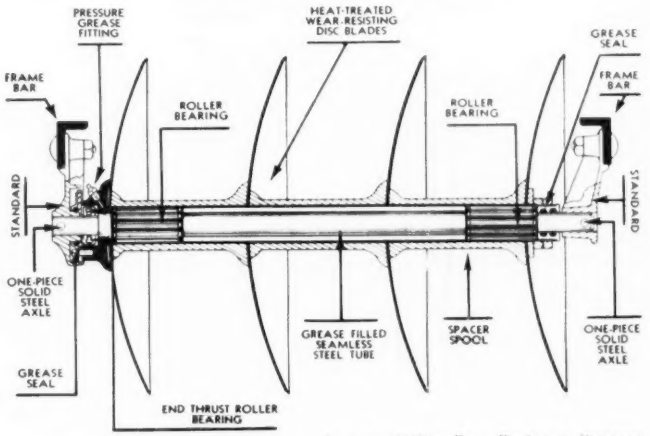
So it is well to remember that the melting point of a grease is controlled by:

1. The nature of the fatty oil used,
2. The nature of the base, and
3. The percentage of soap.

The nature of the alkali used, i.e., whether it is lime soda or other such material, influences the melting point more than do the other factors. In general, lime soap greases are of comparatively low melting point, whereas soda soap products will have fairly high melting points.

### *Consistency*

Consistency is regarded as indicative of the body or degree of hardness of the grease. It also serves as an indication of the texture, as lime soap greases will usually have a buttery consistency, whereas a soda soap or aluminum soap grease will have a long fibrous or spongy consistency. They will vary in hardness, however, according to the amount and nature of soap used in their manufacture, as well as the method employed in compounding.




*Courtesy of Oliver Farm Equipment Company*

Fig. 5—Oliver has developed a unique system for pressure grease lubrication of disk harrow shaft bearings. Note the use of roller bearings, also the grease seal.

## PRESSURE APPLICATION

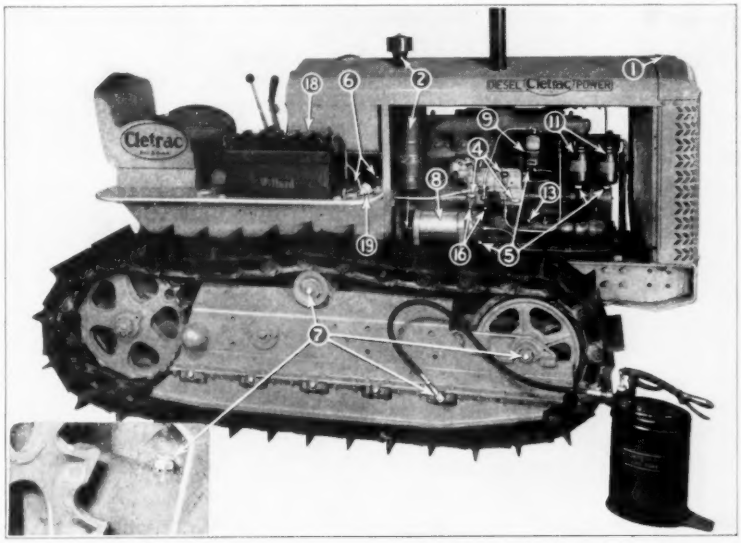
The modern pressure gun is so commonplace today that it is taken as a matter of fact. Few

realize its capabilities when watching its use at a service station. However, its power capabilities are quite interesting, either a hand or foot power gun being able to exert well over 1000 lbs. pressure on the grease passing through the clearance of a bearing. This pressure is often necessary to free some bearings of gummed or oxidized grease, particularly if contaminated with dirt.

It has always been realized that the compression grease cup could never develop much pressure, but as it was low in cost, it served (and still does) many sleeve type bearings sufficiently well. A lot of these must always be used on certain draw bar machinery parts, so the compression cup will still prevail. The pressure gun fitting, however, is preferred for ball or roller bearings.

Tractor builders have, of course, pioneered this move for the engine had to be protected from the very beginning. Later, they too saw the wisdom of the covered gear, the enclosed chain and pressure gun lubrication of sleeve type and anti-friction bearings. So today we find these latter on tractor wheels, front axle and steering assemblies, rear axle counter-shafts and bull pinion shafts. These assemblies can be well housed and when lubricated regularly by pressure gun and a high quality grease, their protection is assured.

The pressure gun, however, can be badly misused. Then it serves to defeat the purpose for which it is provided. Obviously this purpose is to charge a bearing with clean, pure grease.




*Courtesy of The Cleveland Tractor Company*

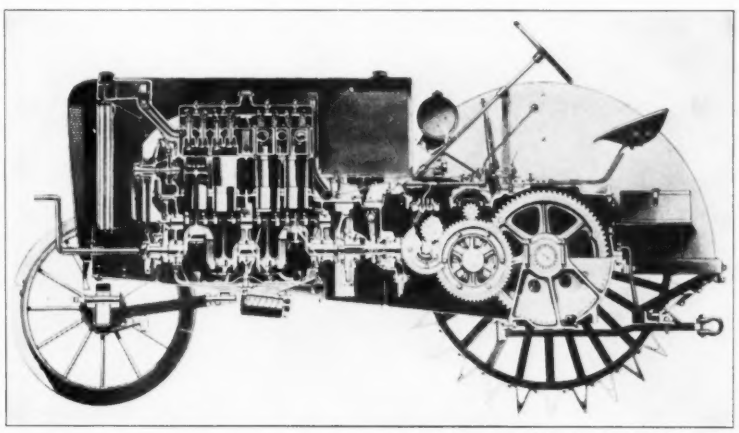
Fig. 6—Showing certain details of the Cleveland tractor. The numbered parts relate to their Cletrac maintenance schedule. For example, Item 7 indicates track wheel bearings and the frame shaft; note lubricator attached.

*To assure of this, all grease containers should be kept covered and guns should be refilled under clean conditions. Later they should be stored under the same conditions.*

## Pressure Lubrication

Lubrication by means of the grease gun requires the use of some form of fitting or nipple equipped with a ball check valve to insure retention of the lubricant. By constructing the exterior of this fitting to conform with the design of the discharge nozzle of the pressure gun, it is practicable to render lubrication virtually automatic and absolutely controllable upon attachment of the power lubricator.

Pressure grease lubrication is comparatively simple for it facilitates the handling of grease in a clean and expedient manner. It furthermore enables the ready forcing out of deteriorated, contaminated or gummed grease from bearing clearances, which otherwise would



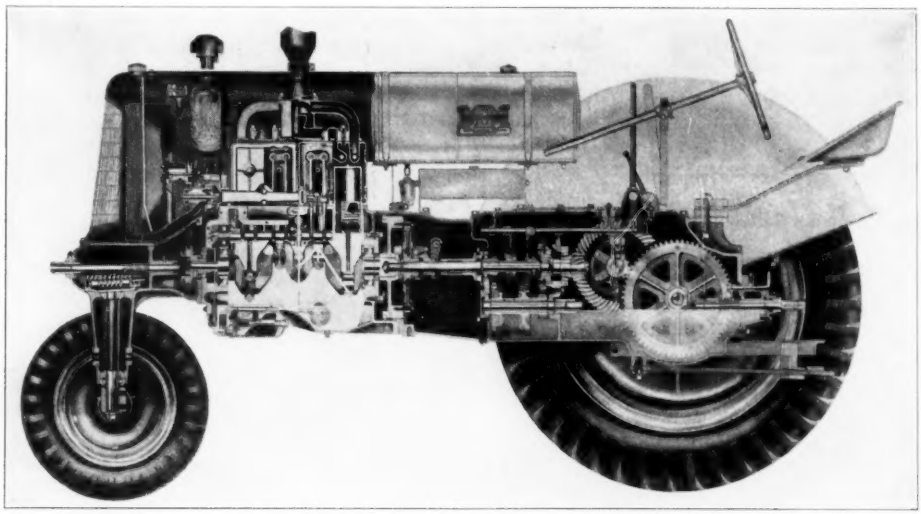
*Courtesy of The Massey-Harris Company*

Fig. 7—Details of a Massey-Harris tractor showing the pressure lubricated engine and oil-bathed gears.

be a decided hindrance to bearing protection.

To be most effective it only remains to make sure that fittings are clean and free from dirt before each attachment of the grease gun.

very soon bring about abnormal wear unless they are frequently cleaned and supplied with fresh lubricant. In addition, rain will tend to wash lighter lubricants from the bearings.



*Courtesy of Minneapolis-Moline Power Implement Company*

Fig. 8—Details of the Minneapolis-Moline tractor showing automatic lubrication of the vital parts of the engine and transmission.

## CLASSIFICATION OF MACHINERY

In a general analysis of farm machinery lubrication, aside from the tractor which furnishes the motive power, we are concerned with two broad classifications, viz.:

Draw Bar Equipment, and

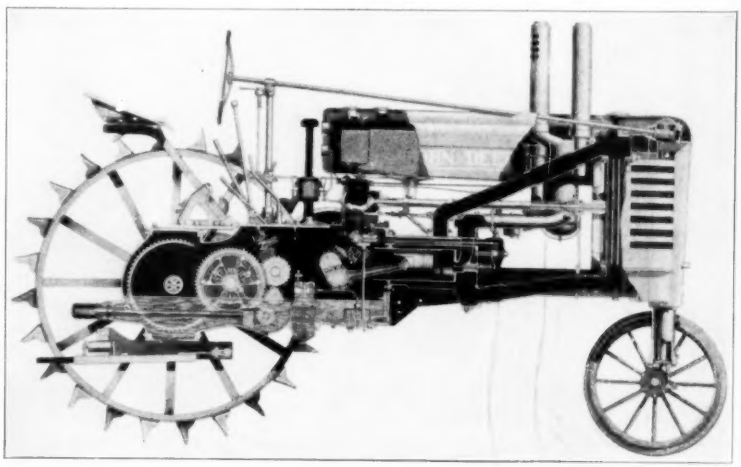
Belt Driven Machinery

The former is most usually applicable to tillage, reaping, and harvesting; the latter to stock feed preparation, lighting units, pumps, saws and other yard machinery.

### Draw Bar Service

Draw bar equipment operates at the same speed as that of the tractor. Normally this requires but few parts to turn over more than about a hundred revolutions per minute. So lubrication is not subjected to any severe speed conditions. We must, however, consider exposure and, very often, load when servicing machines such as plows, harrows, seeders, combines, corn pickers and binders; as a result, many of the bearings, chains and gears will tend to accumulate dust and dirt, which will

As a result of these conditions, modern power farming machinery is being more and more equipped with pressure gun grease fittings and anti friction bearings. Some, however, still must be oiled by hand or through oil cups. These should always be cleaned out as completely as possible before each oiling or else carefully capped to prevent entry of dirt. Where oil cups are installed or hand lubrication is necessary, an S.A.E. 30 engine oil will



*Courtesy of Deere & Company*

Fig. 9—Showing the horizontal cylinder arrangement on a John Deere tractor. Note also the gear assemblies and respective oil levels. Pressure lubrication is widely applied.

usually be suitable. Where grease lubrication is called for, a medium bodied pressure gun grease will give the most satisfactory service.

*Gears and Chains*

Wherever gears and chains are exposed, the nature of their service and their continual operation in the presence of dirt, dust, chaff and straw, renders satisfactory lubrication a practical impossibility. As a general rule, were a suitable gear and chain lubricant applied it would not serve its intended purpose due to the fact that there would often be such an accumulation of foreign matter that excessive power would be required to operate the machine, or the chains might even be thrown from the sprockets in extreme cases. For this reason, chains are often run dry unless each respective roller can be readily oiled through specially drilled oil holes.

On smaller exposed gears which mesh directly, it is usually satisfactory and most economical to use the same grade of engine oil as recommended for bearings. This will be of sufficiently low viscosity to resist accumulations of foreign matter to any great extent, and it may be readily applied with an oil can when other parts of the machine are lubricated.

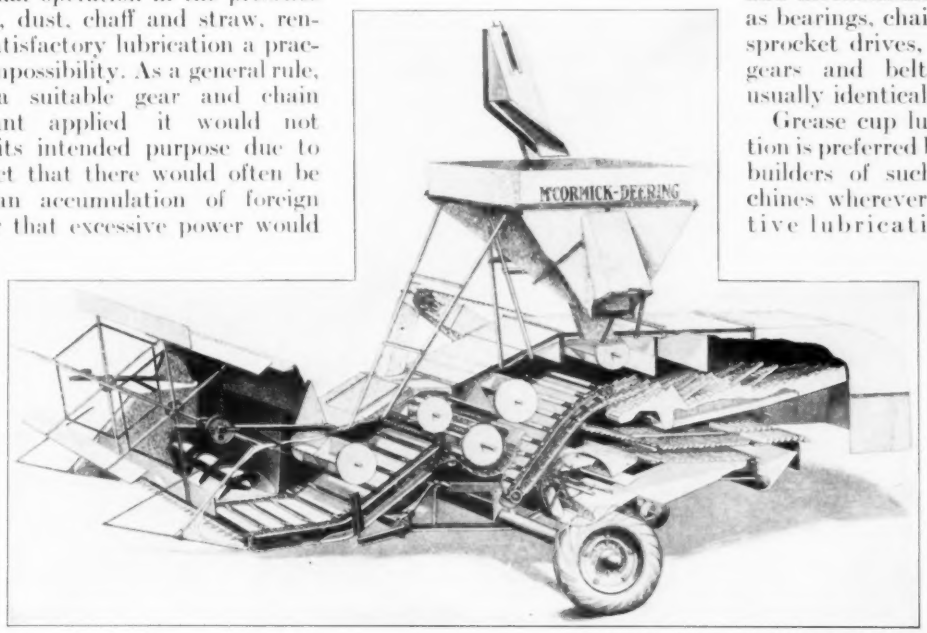
When such gears are enclosed in a relatively tight gear case, a fairly heavy gear lubricant of about 1000 seconds Saybolt viscosity at 210 degrees Fahr., will be satisfactory.

On some parts of equipment such as hay loader cranks, disk-harrow axles and thresher feeder cranks, etc., where duty is not too severe and adequate reservoirs are impractical or too expensive, wood bearings have oftentimes been used. Such bearings are usually oiled by hand and inasmuch as they are porous to a certain extent they tend to decrease shaft wear.

## Belt-Driven Equipment

The belt-drive is applied to the thresher, the ensilage cutter, corn husker, power saw and lighting set, etc. Operating conditions are practically the same, and mechanisms such as bearings, chain and sprocket drives, small gears and belts are usually identical.

Grease cup lubrication is preferred by the builders of such machines wherever positive lubrication is required, although hand-oiling is also necessary.




*Courtesy of International Harvester Company*

Fig. 10—Details of a McCormick-Deering harvester-thresher. Ball and roller bearings are widely used on this machine. Some are packed with grease; others have fittings for pressure gun lubrication. The drive gears are enclosed and run in oil

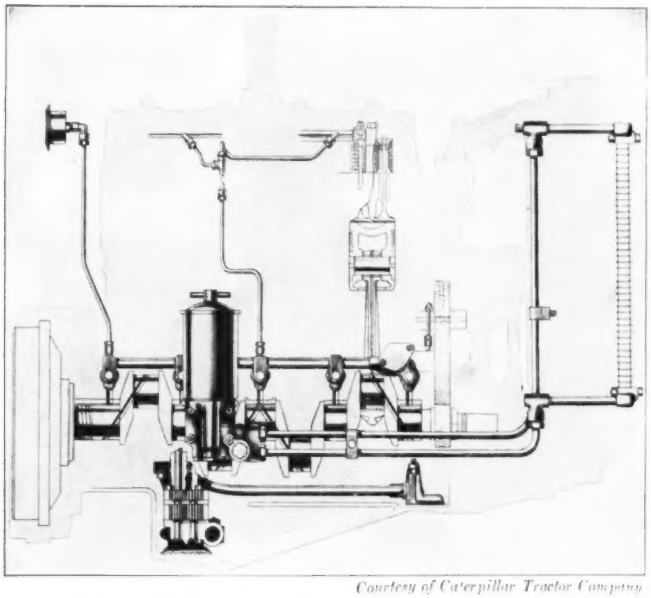
On all such equipment the lubricant will depend upon the means provided for application. For grease cup or pressure gun service a medium bodied product should be used. Where oil is required, an S.A.E. 30 engine oil will be suitable.

It will generally be found most satisfactory on such machines, as on other power farming equipment, to run chains and sprockets dry. The reason for this has already been mentioned. On the other hand, it will often be possible and beneficial to remove chains frequently and clean and dip them in oil. Small gears can be lubricated with the same engine oil or gear lubricant as used elsewhere on the farm.

## The Threshing Machine and Combine

These machines are particularly noteworthy for the attention which has been given to lubrication. They are among the most important machinery on the farm for they must not fail during the threshing season. Any delay in operation traceable to improper lubrication,

such as the occurrence of scored or burned out bearings, may frequently set back the entire harvesting schedule. This may not only affect the net yield of the grain crop but also the



*Courtesy of Caterpillar Tractor Company*

Fig. 11—Details of the oiling system on a Caterpillar tractor engine showing the oil pump (driven from the camshaft), which takes oil from the sump through a large surface screen, to pump it through the oil cooling radiator and filter to the main bearings and all other vital moving parts of the engine.

planting of the next crop, especially where winter wheat is a feature. So the selection and application of suitable thresher lubricants should never be slighted.

The parts to be lubricated include a high speed cylinder shaft and a variety of other bearings, belts, chains and pulleys. Motive power is applied to all these operating mechanisms, either directly or indirectly from the tractor engine, by flexible belt connections.

The thresher often operates under adverse conditions, so the bearings are constantly subject to high pressures and to dust, dirt, chaff and the likelihood of being exposed to rain. For this reason, only high grade lubricants should be used in order to insure as much protection as possible. Often the life of a thresher and its ease and efficiency of operation will be governed by its lubrication.

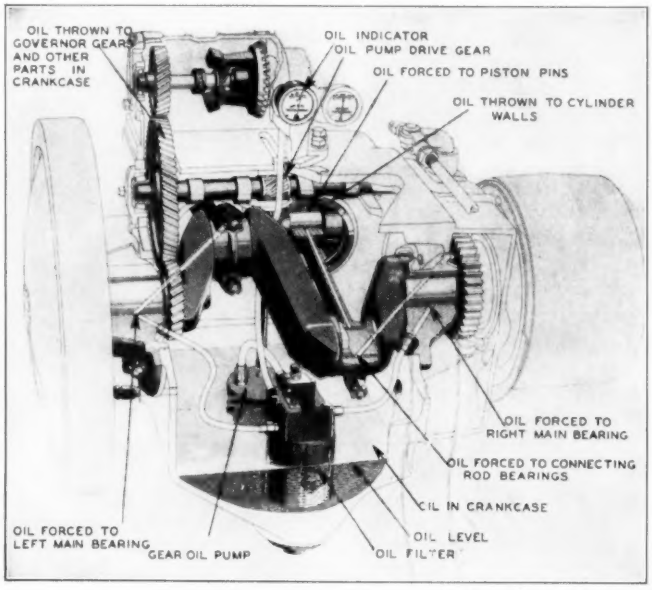
The cylinder shaft bearing is the most important single element. The cylinder speed will vary from 850 to 1400 r.p.m.; according to the diameter and travel speed. A fair average is around 1100 r.p.m. The cylinder is the highest speed unit on the thresher. To assure of dependable operation, it is carried on ball bearings. The use of these latter prevents end play and reduces the possibility of cracked grain. The tapered roller bearing, in turn, is used on the wind stacker fan; cylindrical rollers are adapted to the feeder, beater, shaker shaft, cleaning fan and wheels.

This wide application of anti-friction bearings has led to virtual standardization of pressure grease lubrication and the use of carefully selected lubricants.

Some hand oiling must, of course, also be done on minor parts. So oil holes are often provided. These must always be picked free from dust by the operator prior to oiling (unless they are provided with a hinged cover). This method of lubrication, however, is never as dependable as some form of enclosed oil cup. For such parts, an S.A.E. 30 engine oil will usually be suitable.

### *Inferior Lubricants May Be Most Costly*

Cheap compounds of a relatively light mineral oil and some form of poorly refined fatty oil may be sometimes offered the farmer as substitutes for the better-known branded lubricants. The mineral con-


OIL THROWN TO GOVERNOR GEARS AND OTHER PARTS IN CRANKCASE
OIL INDICATOR
OIL PUMP DRIVE GEAR
OIL FORCED TO PISTON PINS
OIL THROWN TO CYLINDER WALLS
OIL FORCED TO RIGHT MAIN BEARING
OIL FORCED TO CONNECTING ROD BEARINGS
OIL IN CRANKCASE
OIL LEVEL
OIL FILTER
GEAR OIL PUMP
OIL FORCED TO LEFT MAIN BEARING

*Courtesy of Deere & Company*

Fig. 12—Cutaway of the John Deere horizontal engine. Note features of design and details of the oiling system.

stituent of most inferior lubricants will be so light, as a rule, as to have considerable tendency toward evaporation, especially at the shaft ends where exposed to the air, with the result that the remaining lubricant will gum, oxidize and dry out, to probably cause overheated bearings and an increase in power consumption, all tending towards higher costs of upkeep.

*Gears and Chains*

There are a certain number of gears, sprockets and chains involved on the thresher, the lubrication of which is frequently a source of discussion. As a rule, these are run dry, due to the excess of dust, dirt and straw that will always be present. Such chains usually consist either of stamped steel or malleable iron links without rollers or pins. The application of a gear lubricant would in all probability cause straw, dirt and dust to accumulate to such an extent as to hamper the operation of the chains, or even throw them off the sprockets. If desired, however, chains may be removed periodically, cleaned throughly in kerosine, dried and dipped in warm lubricating oil, and drained prior to replacement on the sprockets.

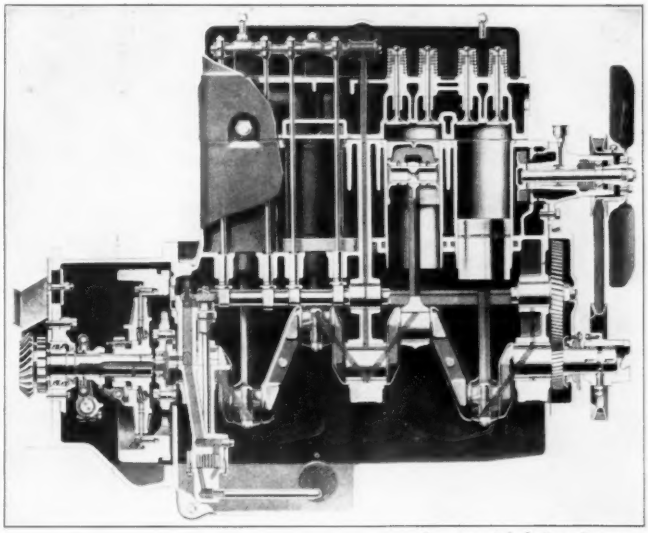
*Overheated Bearings*

Overheating of stacker fan bearings and belt tightener bearings of the plain babbitted type is sometimes encountered and seemingly impossible of being overcome by increasing the rate of lubrication. In such cases, the tightness of the driving belt is usually the cause. An abnormally tight belt will usually cause such bearings to run hot. However, this is no reason for running with a belt so loose as to cause slipping. Judgment in regulating the tightener pulley and regular attention to lubricating equipment will prove the best insurance against such a condition.

## THE TRACTOR

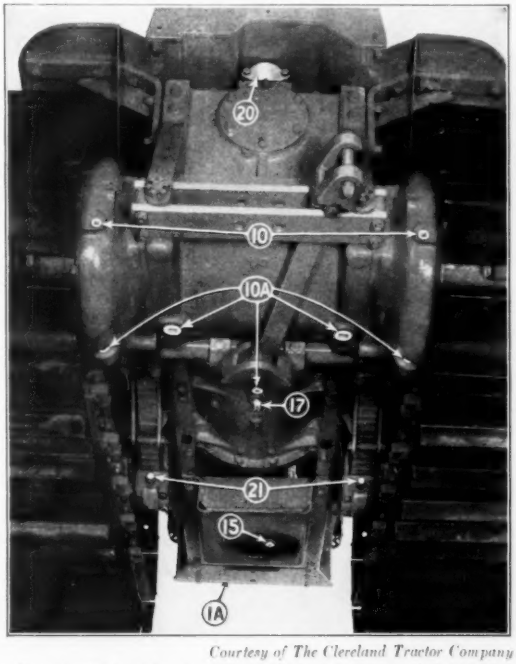
The development of the tractor engine naturally took advantage of the benefits of automatic lubrication. Following automotive practice, the transition was from splash to a combination of splash and force feed; finally some builders adopted full pressure systems. All have proven quite satisfactory when applied specifically to the conditions of design involved.

Fortunately, the farmer does not need to be very much concerned about the method of lubrication employed by the tractor engine builder. His chief concern must be to keep an adequate supply of oil in the crankcase and to change oil regularly in accordance with the engine builder's recommendation and the type of fuel used.



*Courtesy of J. I. Case Company*

Fig. 13—Showing the lubrication system of the Case Series "D" tractor engine. Oil circulation is maintained under full pressure, the system being designed to simplify delivery as much as possible.

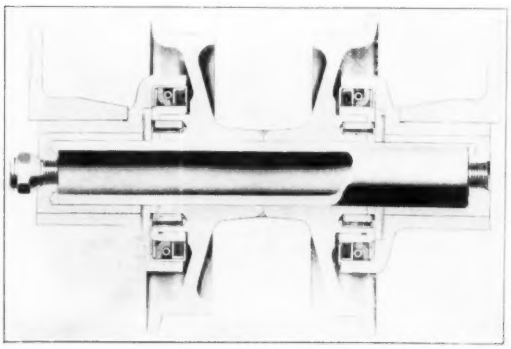



*Courtesy of The Cleveland Tractor Company*

Fig. 14—Underbody view of a Cleveland tractor with lubrication maintenance parts indicated. 10 and 10A are transmission case and rear wheel compartments; 21 indicates the main spring trunnions, and 15 the crankcase oil drain.

It is not quite so much of a "rule of thumb" matter in determining the grade or S.A.E.

number of the engine oil. Here one must study prospective operating conditions and evaluate the effect they may have upon engine performance. They must be thoroughly understood when selecting a tractor engine oil for any particular season. In other words, it is important to know just how the oil will act, not only on starting, especially in cold weather, but also how freely it will circulate and develop protective lubrication. This latter requires an oil which will stand up under the prevailing bearing pressures and maximum engine temperatures; it must also resist breakdown under oxidizing conditions, which otherwise would lead to development of sludge and gummy accumulations.



*Courtesy of Caterpillar Tractor Company*

Fig. 15—Track roller construction on a Caterpillar tractor showing means for lubrication and the dual seals for preventing entry of water or dirt, or loss of lubricant.

## Ease of Starting

This involves both the pour test as well as the viscosity of the oil. Down to a certain point, dependent upon the base and manner of refinement of the oil, the pour test is of considerable value. Then viscosity-shear comes into play. This is the resistance developed within the oil itself, due to shearing effect between its molecules. It becomes more and more pronounced as low temperatures are encountered. As it is due to the presence of certain hydrocarbons which are high in cohesive action, modern refinery procedure endeavors to remove these in the course of refining the oil. This gives the oil a lower pour test, and usually ample physical fluidity at low temperatures to assure that it will pump readily throughout the engine lubricating system. An oil of this type will congeal less readily, hence easier starting will probably be experienced. In other words, sufficient oil will be delivered to the bearings during the warm-up period, when initial lubrication is so important to prevent premature wear.

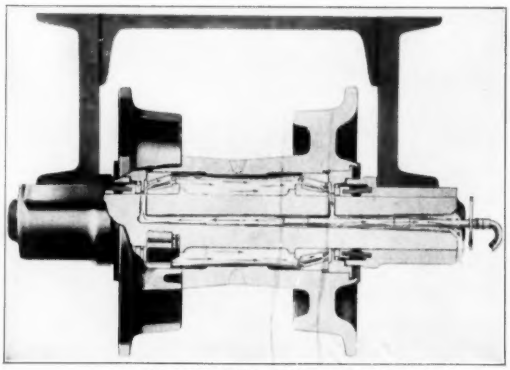
## Viscosity and Heat Resistance

Viscosity is also related to heat resistance. In other words, it is important under either extreme of temperature. The farmer is concerned with heat resistance, because his tractor engine will very often run quite hot, especially when operating belt-driven machinery. The extent to which the oil will withstand heat is an indication of its stability or resistance to decomposition, its tendency to become too fluid and the possibility of burning to hard carbon. A good tractor oil should be capable of working satisfactorily under the usual high temperatures of operation, i.e., it should maintain adequate lubrication, parts protection, and even some cooling.

Viscosity is indicative of fluidity. In other words, it is that yardstick which has been established in order to catalog oils within certain ranges of fluidity. Likewise it is a measure of the resistance which the particles or molecules of an oil will offer to one another as they come in contact in circulation through the lubricating system, or between the wearing elements. Viscosity will vary inversely with temperature, so the hotter the oil, the more fluid will it be; conversely, as temperatures are reduced, it will become less fluid and more sluggish, even to the point of actual congealment if the temperature is low enough. Usually this does not occur with high quality tractor oils until well below zero.

### *Effect on Oil Consumption*

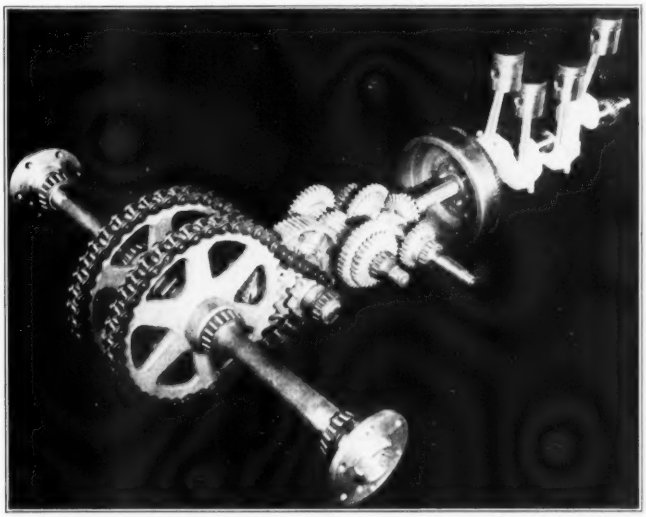
Viscosity also bears some relation to oil consumption. To realize this, it is necessary to appreciate that lubrication requires the development and maintenance of a suitable film of oil on the cylinder walls and within the clearances of all the bearings regardless of operating speed, pressure, or temperature. The



*Courtesy of Allis-Chalmers Manufacturing Company*

Fig. 16—Details of the Allis-Chalmers track roller construction. To lubricate, remove the plug from the end of the shaft and insert the nozzle of the lubricator. Arrows show path of fresh lubricant as it forces out and replaces used lubricant.

latter is especially important, due to the influence upon the fluidity of the oil. In drawbar service, the probable range will be around 300 degrees Fahr. When the tractor is stationary,



*Courtesy of J. I. Case Company*

Fig. 17.—Showing the power delivery and power application working parts on a Case tractor, with housing removed.

however, as in the operation of belt-driven equipment, or in threshing, the maximum average oil temperature may be somewhat higher. Here the cooling effect of the radiator is usually somewhat lower than when the tractor is in drawbar service.

### Engine Deposits

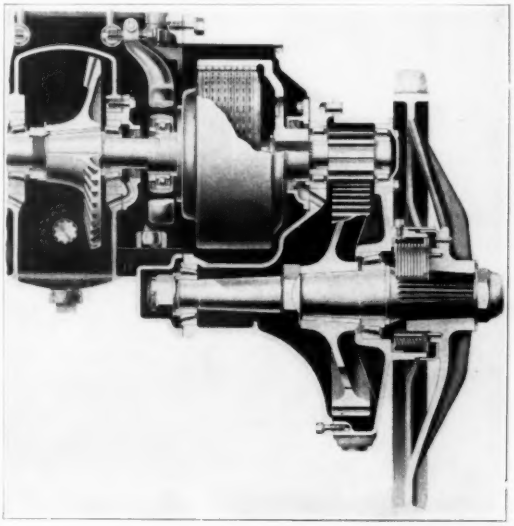
The amount and nature of any non-lubricating deposits in a tractor engine resulting from breakdown or overheating of the crankcase oil, will depend upon the crude source from which the latter was derived and its subsequent refinement. Use of an oil which may break down and develop such deposits under severe temperature conditions may easily result in insufficient lubrication, increased oil consumption, scored or burned out bearings, excessive wear of piston rings and cylinder walls, oil pumping, stuck rings, and obviously increased maintenance costs.

Combustion of the fuel in the presence of an excess of air develops a chemical reaction which converts the fuel hydrocarbons to carbon monoxide gas, water and other minor compounds, which are passed out through the exhaust. If the fuel is adapted to the engine and conditions of combustion are right, any residual carbon in the form of soot is very slight. The same holds true for residual tarry matter. Should it become so excessive, however, as to be deposited on the spark plugs, pistons, valves, or cylinder heads, "knocking," under overload will occur.

It has been stated that when the fuel burns clean, the amount of residual carbon or tarry matter is usually very slight. This same condition applies to any crankcase oil which may work upward past the piston rings into the combustion chamber. Well-refined lubricating oils will develop scarcely any carbon upon subsequent combustion, and from many the carbon residue will be so soft and non-adhesive as to be carried out by the exhaust. As formation of carbon residue is increased by dirty or dusty air, and as such residues are cumulative in nature, some engine deposits must always be expected after continued operation, especially in dusty air for many hours. Hence the need for periodic engine cleaning; likewise, cleaning of the air filters as the builders advise.

## POWER TRANSMISSION

The transmission of power from the tractor engine to the rear axle and wheels requires certain speed change mechanisms in the tractor, just as it does in the automobile. This is attained by locating a transmission between the engine and the differential or final drive.



*Courtesy of Caterpillar Tractor Company*

Fig. 18.—The Caterpillar final drive showing types of bearings used.

The geared transmission requires careful lubrication. It involves both gears and bearings and oftentimes the use of lubricants of quite varying character. The final drive or

differential involves the use of worm, spur, bevel, or annular gears.

Lubrication of such an assembly is essentially a matter of combined gear and bearing lubrication, wherein the lubricant must serve a dual purpose. In the majority of tractors today, the transmission is enclosed in an oil tight casing, and bath lubrication is made possible. When the tractor is in motion, heavy loads are carried by both gears and bearings. The lubricant, therefore, must be of just the right viscosity or body in order to assure of adequate coverage of all these parts and the maintenance of a suitable oil film of minimum internal friction. This same lubricant must also protect the gear teeth from wear and reduce noise during operation.

### Viscosity Range

There is always a certain amount of latitude relative to the viscosity or body of the lubricant which should be used in a geared transmission. The controlling elements are the type of bearings and constructional conditions involved. The range is all the way from an S.A.E. 30 motor oil to an automotive gear lubricant. Where installations are equipped with anti-friction bearings on the gear shaft and the one lubricant serves the entire unit, a lighter oil is often used (according to the temperature conditions), than where bearings are built to require grease lubrication. Such an oil may range from S.A.E. 30 to S.A.E. 80. Heavier oils up to S.A.E. 250 are, in turn, often required for gears designed for lubrication apart from their bearings.

### Oil Level in the Gear Case

A tractor gear case should never contain more than just enough lubricant to insure that the teeth of all gears on the lowest shaft of the transmission will dip in the lubricant. This will promote the most effective lubrication; any increase in the amount of lubricant in the case will impose a "drag" on the gears, especially in cold weather. Tractor builders usually indicate on the case itself, or by instruction book, just how much gear lubricant should be carried in each model.

### Fluidity Most Important

A tractor gear lubricant should possess sufficient fluidity so as to follow the gears readily. This requires that the farmer consider the pour test when selecting such a lubricant for cold weather service. This test indicates that temperature at which the lubricant becomes so sluggish as to cease to flow. A zero pour is advisable for any type of low temperature service; likewise, a somewhat lower viscosity. Even a properly filled gear case is not dependable if the lubricant therein does not remain comparatively fluid under low temperature operation. In such an event, the gears would channel through it, and any lubricant sticking to the sides of the case would not flow readily back to the bottom.

Where the transmission is not enclosed, a lubricant must be used which will stick tenaciously to the gear teeth and not be thrown off by centrifugal force or affected by water. For this purpose a heavy bodied straight mineral industrial type of gear lubricant of from 1000 to 2000 seconds Saybolt viscosity at 210 degrees Fahr., is advisable.

### The Final Drive

Final drive or differential lubrication requirements are quite similar. These assemblies may include spur gears, internal gears, chains, worm or bevel gears, according to the design of the machine; the spur gear predominates today.

In turn, where chains or gears operate exposed, it is necessary to use a gear lubricant of about 2000 seconds Saybolt viscosity to take up the shock and strain so often incurred, which would squeeze any lighter lubricant out from between the gear or sprocket teeth.

In driving chain lubrication, the lubricant must serve likewise as a lubricant, as well as a protective agent. These objectives are attained by treating the moving parts so that penetration of the lubricant will occur to the innermost elements. For this purpose, a straight mineral lubricant having a viscosity of from 500 to 1000 seconds Saybolt at 210 degrees Fahr., will be best suited. This should be applied hot, preferably by removing the chains and immersing them in a pail filled with the lubricant. They should then be hung up to cool and drain off excess lubricant. Oftentimes it is advisable to wash such chains in kerosine before relubrication.

## CONCLUSION

We have presented this discussion of farm machinery lubrication fully realizing our limitations in being able to add to the store of knowledge already possessed by the progressive farmer.

That is why we brought up such matters as lubricant characteristics. At least, there, we were on our own ground, and could stress those features which denote quality in certain petroleum products.

As already suggested, however, performance and dependability are the best indications of quality. They go far beyond words. But as each is a measure of the other, if quality lubricants are used from the beginning, better performance, greater dependability, and lower maintenance costs can usually be expected.



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"RAISING PRIZE WHEAT takes plenty of care, thought and hard work," says Mr. Betzen, whose Cheyenne wheat won first prize at the Woodward County Fair, Oklahoma. "That includes having ground prepared at the right time and using good seed.

"Taking proper care of farm machinery pays, too. You certainly can't afford to have your tractor need repairs right in the middle of planting time. That is why we use Insulated Havoline Motor Oil and Marfak lubricant. We've found them to be the right combination for dependable low-cost operation."

A tractor engine running at high speed can get so hot that ordinary oils frequently form varnish which slows the motor, and can cause pistons to "freeze."

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*Texaco Marfak* is so tough it lasts twice as long as ordinary grease. It resists the effect of heat. Pressure won't squeeze it out, rain won't wash it out. Made with heavy oils combined in a special base, Marfak not only sticks to metal, but also sticks together. It pays to lubricate your farm machinery with Marfak.

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# BOTH NEED *Expert* CARE!

Militor Emma's **VALLEY BOY OF LAKEVIEW**, owned by George L. Hendress of Sheldon, Ill. His tractors are lubricated with Havoline and Texaco Marfak.

"VALLEY BOY OF LAKEVIEW was named grand champion at five county fairs for seven years in a row. He has a butterfat record of 1,106 pounds on the dam's side. That dam sold for $5,500. Valley Boy had the best of blood lines to begin with and has always been given the best of care. So I'm sure that it takes expert care to get the best results.

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Farm tractors, running at full throttle 80% of the time, develop heat that breaks down ordinary oils, forming varnish and sludge, slowing speed, causing power loss and excessive fuel consumption. Havoline is *insulated against heat.* It stands up, gives full protection.

*For tractor and truck chassis* lubrication, use Marfak. Bumps won't squeeze it out, rain won't wash it away. Made with heavy oils combined in a special base, Marfak clings to metal, sticks together, resists friction and makes machinery run more economically.

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